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ance wave coils, both open at one end and at both ends, for general radio work offers an interesting field for investigation. This involves the study of the electron tube as a potentially operated device. The application of such coils properly designed for specific purposes may lead to the practical solution of a number of radio problems such as directional effects, and wave coils antennæ of very small dimensions.

4. The account of the experiments thus far conducted and the reasons which have led to the undertaking of these experiments on the part of the Signal Corps, are presented to the National Academy of Sciences at this time in conformity with the new spirit of organization for national and international research so admirably typified by the National Research Council which is under the general direction of this official body.

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RÉSUMÉ OF RESEARCH IN THE PSYCHOLOGY OF AVIATION DURING THE YEAR 1919

THE writer has been in charge of the department of psychology of the Air Service Medical Research Laboratory since January 15, 1919. Members of the department engaged in research during that year included Drs. F. C. Dockeray, D. C. Rogers, H. C. McComas and J. E. Coover, as captains; Dr. English Bagby and Mr. Schachne Isaacs, as lieutenants; and Dr. F. C. Paschal, Miss Barbara V. Deyo and Mrs. Cressie Campbell Merriman, as assistants. Certain members of the group were present for but a short time; and others were present for several months. Dr. E. N. Henderson and Mr. L. J. O'Rourke, as captain and lieutenant, respectively, were connected with the department for some time, but the exigencies of the service did not permit of their em-

ployment in research. Since October last the staff has consisted of Lieutenant Isaacs and the writer, with Miss Deyo and Mrs. Merriman as research assistants.

During the year the department prosecuted research along two distinct and independent lines: (1) an effort to gain a somewhat more intimate acquaintance with the effects of low oxygen on the integrity of response; and (2) an effort to develop more sensitive tests for the detection of (a) general aptitude for aviation work and (b) of its deterioration in the earlier stages of staleness. The reports of this work will probably appear in due time in the various American psychological journals, under the names of the authors who are individually or jointly responsible. Meanwhile, a résumé of the year's activities of the department as an organization may not be out of place here.

An extensive and detailed statistical study of the records of over 6,000 classification-tests for resistance to deprivation of oxygen, has been made under the direction of Captain Coover. He was assisted by Lieutenant Isaacs, Dr. Paschal, Miss Deyo, Mrs. Merriman and the writer. The results indicate the extent to which the subject's performance may be affected by atmospheric pressure, temperature and humidity; by the absolute quantity of oxygen supplied the subject in the air to be rebreathed; by the duration of the test; by the time of day at which the test is taken; by the judgmental eccentricities of the psychological and clinical observers; and by a lowered morale, such as that which immediately followed the armistice. With these data available it is now possible, by controlling or correcting for the influence of these variables, to approximate much more closely to uniformity and constancy of the standards of classification than has been possible hitherto.

An attempt was made by the writer, in collaboration with Dr. Paschal, to demonstrate the progress of impairment of behavior by the use of an objective record of the speed and accuracy which the subject can maintain in carrying on work of uniform difficulty as the supply of oxygen is being diminished.

(The subject was required to encipher a number of sets of nonsense-material into specially prepared codes, both the material and the ciphers being selected for uniformity in the distribution of difficulties.) Some interesting records were obtained, which, however, do not give the quantitative measure of impairment which the appearance of the graphs suggests. One reason for this fact is that many subjects tend to compensate for impairment of response by an increase of "voluntary" effort. The fact can be noted by the observer, and such clinical notes are necessary to correct interpretation of the "quantitative" data.

Some tests on the fluctuations of visual acuity over extended periods of observation were made by the writer, using in general the method described by Cobb;¹ the test-field, however being a real image of the pattern of the Ives-Cobb visual acuity test-object, slightly magnified on one half and slightly reduced on the other, projected into the plane of an opening in a screen 60 cm. from the eye. Some results thus obtained were not fully expected; *e. g.*, (1) it appeared that fixation and accommodation upon a stationary object can be maintained until the last stages of asphyxiation have been reached; (2) that disturbance of the visual function is not exhibited by this type of test until the more highly coordinated processes have actually begun to fail; and (3) that in the last stages of asphyxiation, visual impressions may become intermittent and the entire field become darkened, without the outlines of objects appearing blurred, and without diplopia developing under the conditions of this particular test. It should be remarked, however, that these conditions are much less trying than those which compel coordinated eye-movements to be executed within a limited time; and that the latter conditions often elicit and exhibit marked disturbances. This work will probably be carried farther.

Dr. Rogers perfected an attachment for the Henderson rebreather by means of which the

¹ Cobb, P. W., "The Influence of Pupillary Diameter on Visual Acuity," *Am. Jour. Physiol.*, 1915, Vol. XXXVI., pp. 335-346.

rate of diminution of oxygen can be controlled, within reasonable limits, through the replacement of a known proportion of the oxygen consumed within a given time. The apparatus is considered superior in some respects to one previously used in another department, and its employment assures that different subjects can be made to experience comparable degrees of oxygen-hunger for comparable times.

An investigation was made by Dr. McComas on the influence of diminished air-pressure, simulating an altitude of 20,000 feet, on the time required for selective reaction to a number of combinations of signals visually perceived. The experiment being exploratory in character, and the time of the experimenter being limited, it was not feasible to introduce certain controls which otherwise would have been desirable. However, the data as obtained indicate that the time required for selective response is greatly lengthened and its variability increased, by the abnormal conditions of the experiment, until the subject by continued practise has rendered his responses almost purely mechanical. The results obtained in the later stages of training are open to more than one interpretation, and it is planned to resume experimentation as soon as may be practicable.

Dr. Bagby made a systematic contribution in the form of a study entitled "A psychological point of view in psychiatry, with special reference to pathological behavior under deprivation of oxygen." This report calls attention to manifestations of emotional instability which sometimes occur during the rebreathing test in the absence of adequate external stimuli. The display under such conditions of anger, fear, destructiveness, excessive nonchalance, silliness and euphoria, is compared with symptoms of alcoholic intoxication, and with characteristic symptoms of certain types of insanity. The opportunity incidentally afforded by the test, of observing evidences of lack of poise which are not necessarily prominent in the normal state, is emphasized.

A study of associative responses was begun

during the summer by Dr. Bagby, for the purpose of exhibiting the extent to which pathological reactive tendencies, existing normally in a state of repression, tend to be released under diminished barometric pressures corresponding to fairly high altitudes. The author was separated from the service before the work was completed, but not until after an excellent collection of test-material had been compiled and tested. Arrangements have been made to have the work completed by Lieutenant Isaacs, as soon as the low pressure chamber has been installed in its new location.

The results of the tests of aptitude for flying, administered by Drs. McComas and Bagby at Taylor and Souther fields under the direction of Major Stratton in 1918, were worked up in the department under the direction of Dr. Coover, with the assistance of several members of the staff. The data indicate that the tests taken as a group have some diagnostic value and that certain of the individual tests if further refined may have considerable practical value. An important fact exhibited by the data is that flying grades do not adequately differentiate aviatational ability. About 85 per cent. of the cadets tested at one field was rated within a range of five points on a scale of 100. This means, practically, that a certain grade was taken as expressing the rating "Fairly good," for example; and that practically all the men so regarded received the same grade, no means being provided for ranking them *within* the class within which they fall. This makes a comparison of flying grade with other scores, quite difficult of interpretation.

The results of a number of tests of aviatational ability used by Captain Dockeray and Lieutenant Isaacs in the A. E. F. were worked up by those authors here. The data show that the scores of the subjects in two of the tests are highly correlated with the estimate of aviatational ability as made by the training department, the coefficients in both cases being approximately 0.73. It is safe to say that if six to eight tests as satisfactory as these were developed, they would afford a

better basis of prediction of flying-school performance than is afforded by the cadets' records in civil life, or by their performance in ground school, etc. It is planned to continue the effort to develop such tests.

Preliminary work in the department suggested that two forms of test, if sufficiently refined, might prove to be quite valuable in diagnosis of aviatational ability and in exhibiting its impairment. These tests are (1) of the ability to control the coordinated activity of certain systems of voluntary muscles; and (2) of the *relative* time required for selective reaction to one of three signals presented successively and in irregular sequence (*a*) under a standard condition of observation and (*b*) under a condition of observation so difficult as to be trying. This work is still in the early stages, due largely to the delay in making the annual appropriation available, and to the general disorganization and turmoil incidental to the closing of Hazelhurst Field and moving the laboratory hither.

In addition to the research activities recapitulated above, some considerable energy of the department was devoted to supervision of the psychological features of the routine tests run at branch laboratories; to the administration of classification-tests at the local fields; and to cooperation with other departments in the administration of tests in which the department of psychology was not directly interested.

Courses in psychology were given to three classes of military physicians in training for the work of flight surgeons. These courses covered: fundamental presuppositions of the science of psychology as defined by the more prominent contemporary authors; the rudiments of psychophysical methods and technique; an introduction to elementary statistics, including measures of central tendencies, variability and correlation; the psychological features of the classification-tests used in the Air Service; and an introduction to the concept of the wish as a unit in behavior. While most of these students made quite a creditable showing it has since been deemed advisable to discontinue the work in statistics

and to substitute for it work bearing directly on the "personality study" which these physicians are required to make of their wards.

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GENERAL BIOLOGY AND THE JUNIOR COLLEGE

BIOLOGISTS are much indebted to Professor Nichols for his excellent summary of sentiment in respect to the so-called "General Biology" course. His survey would appear to indicate that possibly a majority of biologists believe that a year's work, consisting of a half year each of introductory botany and zoology, is general biology or is at least a preferable substitute for it. In a recent article Professor Henderson expresses his dissent from this view and raises the question of the relation of this course to general culture and the junior college. He says:

I take it as axiomatic that there is a certain minimum of information regarding matters biological which every educated man ought to have . . .

and

It seems—at least some of us hope—that to-day we are about to see a displacement of the academic course in favor of the junior college, which would give such general subjects as the languages, American history, elementary chemistry and physics, and the one or two other things which every one should have; . . .

The Junior College.—That there is already a strong current of sentiment toward the junior college is a fact of which one can scarcely remain unaware. For this there appear to be several reasons. In the first place many of the larger universities are fairly swamped with students of immature age in respect to the nature and content of the courses offered them. A second and possibly more important reason is that such junior colleges can be established and maintained in most larger towns and cities. This results in a desirable saving in expense to the student. Its chief advantage to the university lies in

the fact that it frees it from overcrowding and acts as a desirable preliminary period during which there is likely to occur a sorting out of the students better qualified by ability and interest to pursue the professional courses of the university.

In the third place our universities are showing stronger and stronger tendencies away from "general culture" courses. To the small college is left, in large measure, the task of imparting general culture. Modern education consists, then, either in a series of years devoted wholly to general culture, or in an equal period of specialized, more or less technical study, the determining factor being whether the student happened to attend a small college or one of the larger universities. The exigencies of modern life forbid, in the case of many individuals, and render of doubtful value for others, the spending of four years in acquiring general culture. On the other hand, a curriculum devoted wholly to specialized training is thought by many intelligent persons not to afford a liberal education, at least in the best sense of that term. The junior college offers a feasible, if not an ideal, solution of the difficulty by allowing (or perhaps requiring) two years of general culture on which may be superposed two or more of specialized training.

An important feature of the junior college which commends it to many is the limited election which its organization permits. The immature student may well be compelled to form acquaintance in an elementary way with the subject matter of the chief lines of human endeavor, and, what is more important, with the point of view and habits of thought of workers along these lines. Too free a range of election in the earlier years hinders this attainment of broad outlook by tempting the student to follow along familiar pathways. With distressing frequency is the spectacle presented of students clinging to certain groups of courses because they feel reasonably sure of success therein, whereas their own best educational interests demand that they venture into strange fields and feed on untried pabulum.